DOCUMENT RESUME

ED 297 294 CS 009 246

AUTHOR Wheeler, M. Candace
TITLE Correlation between Remedial Students and Learning Styles: Implications for Computer Assisted Instruction.
PUB DATE 88
NOTE 48p.; Master's Thesis, Eastern Washington University.
PUB TYPE Dissertations/Theses - Master Theses (042) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Cognitive Style; *Computer Assisted Instruction; *Computer Software; Elementary Education; Grade 6; Remedial Programs; *Remedial Reading
IDENTIFIERS Education Consolidation Improvement Act Chapter 1; Reading Style Inventory (Carbo)

ABSTRACT

A study investigated the learning styles of remedial students and the implications for computer-assisted instruction. The subjects were 31 sixth-grade Chapter 1 students from a middle school in Idaho who did not have learning disabilities nor were candidates for special education. The subjects were given the Reading Style Inventory (RSI). Results indicated that all subjects had a strong to moderate kinesthetic preference and most had high visual strength. The implication is that computer software which emphasizes problem-solving and simulation will address the particular learning style of remedial readers. (One table of data and two figures are included, and 38 references are attached.) (RS)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED297294

Correlation Between Remedial Students and Learning Styles: Implications for Computer Assisted Instruction

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
M. Candace Wheeler
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☐ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

M. Candace Wheeler
Eastern Washington University

In Partial Fulfillment of the Requirements
for a Masters Degree in Computer Education
Spring 1988

CS009346

running head: Learning Styles/Computer

ABSTRACT

Correlation Between Remedial Students

and

Learning Styles:

Implications for

Computer Assisted Instruction

by

M. Candace Wheeler

This study investigates the learning styles of remedial students and the implications for computer instruction. Literature was reviewed to determine if through a learning style testing instrument, predictions could be made about the remedial student's learning preference. Literature was also reviewed concerning which type of computer software facilitates greatest achievement for the remedial student.

The population for this study was 31 sixth grade Chapter One students from a rural community in Idaho. All students in the study were administered the Reading Style Inventory (RSI). All of the students tested (100%) scored in the strong to moderate range for kinesthetic preferences. When this information is applied to a decision on computer software, a holistic format lends itself to the remedial student's learning style.

The results indicated that remedial students do have similar learning styles. This study supports the position that the computer will have more impact on the reading

curriculum when educators apply what can be learned by Reading Style Inventories. Individualizing the computer format to match a student's learning style will maximize the predictability of successful learning.

TABLE OF CONTENTS

I. CHAPTER 1

Introduction.....3

Significance of the Study.....3

Definition of Terms.....8

II. CHAPTER 2

Introduction.....9

Design of Computer Software.....9

Learning Styles.....13

Computer Software Format and Learning Styles....18

Summary.....25

Problem Statement.....26

Hypothesis.....26

III. CHAPTER 3

Methodology.....27

IV. CHAPTER 4

Results.....30

V. CHAPTER 5

Discussion.....32

VI. BIBLIOGRAPHY.....36

VII. APPENDIX A.....42

VIII. TABLE.....43

IX. FIGURES.....44

CHAPTER I

Introduction

How does one assign students to alternative instruction treatments in a way that maximizes pay off? The decisions as to the optimal instructional strategy for each student is very complex. This study is concerned with placement of students in particular learning activities on a computer that addresses the dominant learning style of the student to facilitate learning. This study will review the research on learning styles and computer assisted instruction to develop sophisticated individualized computer instruction activities.

Significance of the Study

Computers in Schools

Computers are available in the schools. There was a national survey by Becker (1983) in which 2,209 public, private and parochial elementary and secondary schools in the United States were asked several questions about computers. The rate of return of the information was 96%.

It was found that the majority (53%) of the schools had at least one computer. The primary use of computers at the elementary level was drill and practice (57%). The primary use of computers at the secondary level was programming (76%).

These findings are also supported by a meta-analysis of research on Computer Assisted Instruction (CAI) by Rapaport and Savard (1981). Eighty-two studies were analyzed. The hypothesis of all the studies was: computer assisted instruction, when combined with traditional instruction, leads to higher achievement than traditional instruction alone. Two studies were excluded because their methods were weak. Six studies were inconclusive regarding the hypothesis. Three studies denied the hypothesis. Seventy-one studies supported the hypothesis. Computers are in the schools and they are being used as instructional tools. This was confirmed by further studies by Feurzeig, Horwitz, and Nickerson (1981).

There is a more refined summary of CAI research that coded the variables to see if different classes of children and different forms of CAI produced different results. This meta-analysis by Niemiec and Walberg (1985) combined the work of 48 separate investigators. The conclusion was that lower achieving, exceptional, and younger students achieve more on CAI than others. This was supported by similar findings by Schmidt, Weinstein, Niemiec, and Walberg (1985-1986).

Computer based instruction, as supported by research, is a method that leads to higher achievement. Some types of learners achieve more than other students by using the computer. The decision to individualize instruction should take into account the type of learner, the computer as an instructional tool, and the content of the computer program. According to McCombs, Eschenbrenner, and O'Neil (1973), a truly adaptive instructional computer program should also incorporate learning styles.

Learning Styles

The basis of learning styles was first addressed by neurologists. By direct observation, behavior changes that followed brain damage from stroke or wounds were compared with autopsy findings after the patient died (Harris, 1979). This kind of clinical research helped to identify the connection between brain areas and functions. In the 1950's, sodium amytal was used to explore the hemisphere that is dominant for language. In the 1960's, a few patients with severe intractable epilepsy were treated by cutting the fibers that connected the two hemispheres. Studies of these patients by Levy, Trevarthen, and Sperry (1972) revealed that each hemisphere is dominant for some functions and nondominant for others. Gazzaniga, Bogen, and Sperry (1965) conducted similar studies concentrating on

motor response to right and left visual stimuli after surgery to the cerebral hemisphere. They found that visual activity is represented in the right hemisphere.

In education, we have used indirect methods for indicators of brain dominance. There has been a development of assessment instruments to identify cognitive styles to facilitate the teaching/learning cycle by matching similar cognitive styles. Research by Sharp (1982) was done to validate learning style instruments and their correlation to achievement. There has also been research to see if matching learning styles with teaching strategies influences achievement. A meta-analysis by Griggs (1985) listed 26 studies that indicated there is significant improvement in achievement when individual learning style preferences are accommodated through complementary teaching styles, instructional approaches, or resources.

There has been more focused research in learning styles that looks at a particular class of students. Price, Dunn, K., Dunn, R., and Griggs (1981) did research on the learning styles of 109 gifted students plus 160 random sample students. The variables isolated in the research were formal or informal classroom design, sound, structure or non-structure of directions, completion of tasks, student motivation by a teacher, and persistence to achieve goals. The gifted students preferred a formal classroom design with a quiet atmosphere. They did not need structured directions such as time lines and were less responsible in that they

completed tasks in their own way. The gifted student also wanted to please the teacher and was more persistent or goal oriented than the non-gifted group. The above areas were labeled design, sound, structure, responsibility, teacher motivated, and persistence. The results showed these six variables did discriminate significantly between gifted students and randomly selected non-gifted students.

A study by Zenhausern, Dunn, Cavanaugh, and Eberle (1980) also looked at the learning styles of different academic achieving students. They gave a testing instrument to 20 good readers and 20 poor readers to differentiate right and left hemispheric activators. The good readers were classified almost equally between right and left activators (11 left and 9 right); however, 17 of the 20 poor readers were classified as right activators.

Learning styles testing can predict right or left hemispheric dominance as shown in the studies by Sharp, Griggs, Price et al, and Zenhausern et al. Knowledge of the learning style could help in the selecting and designing of instructional computer strategies to facilitate learning.

Definition of Terms

Computer Assisted Instruction (CAI): For the purpose of this paper, this term will mean the use of computer software to support the objectives of the curriculum.

learning styles: For the purpose of this paper, this term will be used to describe the visual/auditory strengths and the kinesthetic/tactual preferences of learners.

Chapter One student: For the purpose of this paper, this term will mean any student who is more than six months below grade level and enrolled in a federal remedial program in the public school system.

CHAPTER II

This study will review three areas of research. The first area is computer software design. There are several options in software formats available to support instruction. The manipulation of computer formats does facilitate achievement. The second area to be addressed is the neuropsychological research that deals with learning styles. Research supports that learning style characteristics, visual/auditory strengths or kinesthetic/tactual preferences, are predictors of high or low achievers. Instruction that takes into consideration the learning style of the student does increase achievement. The third area of the research review deals with how learning styles are dealt with in computer software formats. Different formats lend themselves to different cognitive processes. Research supports that remedial students have higher achievement with certain computer format designs.

Design of Computer Software

In choosing computer software, there are two areas of concern: 1.) what type of software is available and 2.) how does it meet the needs of your student population. According to a book by Bitter and Camusa (1984), Using a

Microcomputer in the Classroom, there are six basic structures of CAI: drill and practice, tutorial, simulation, computer managed instruction, problem solving, and word processing. Each of these structures allow for different types of responses from the student and different amounts of student control. Drill and practice is extremely structured while word processing is open ended. This book has several evaluation forms which can help educators categorize and evaluate software using principles of learning. Following are two studies that address computer software format design and achievement within the six categories mentioned.

Tennyson (1980) designed and tested the Minnesota Adaptive Instructional System. It is tutorial in structure but the designer made two conscious decisions that were built into the content. The program would have learner-adaptive controls. This means the learner decides whether to have more examples or go to the posttest. Also the concepts to be learned would be presented with coordinating relationships, meaning examples, instead of a design strategy that presents concepts successively. The sample was 135 undergraduate students randomly assigned to two groups. The control group was given the content by software which gave the information in successive steps with no learner control. The experimental group was given the content by software which gave examples and learner control. The data analysis consisted of a multivariate analysis of variance (MANOVA) with univariate tests (ANOVA) on each

dependent variable. The MANOVA on the main effect of control structure was significant at $p < .01$. The test on the second main effect, learner management strategy, was likewise significant at $p < .001$. The ANOVA on the posttest correct scores showed a difference between the two content structure conditions. Students in the simultaneous condition had a posttest score of 4 points higher that students in the successive condition. In terms of the percentage of items correct, the simultaneous condition was 74% correct, whereas the successive condition was only 58% correct. The discussion states that manipulation of the elements in a content structure on the computer can directly influence a student's level of concept attainment.

Tobias (1973) looked at another aspect of computer software structure. The content of his software was interrupted by a programmed set of distractors. His purpose was to see what effect distractions had on achievement. The sample was 120 college students randomly divided into two groups. They were to learn a content material by computer. The learner had control of the frame changes. One group's program was structured so that every three seconds a three syllable nonsense word would flash on the screen. The data were analyzed by multiple linear regression. Contrary to prediction, distraction did not affect achievement ($F = 2.81$, $df = 1/113$), though it increased time on program ($F = 5.02$, $p < .05$). Constructed responding led to higher achievement ($F = 60.08$, $df = 1/113$, $p < .01$). The conclusion

was that learner control of the speed of the frames is an important aspect of computer software structure. Thus, the type of software format which allows for student control of the speed of the frames does impact achievement.

Learning Styles

Neuropsychological research can provide a basis for the understanding of how to interpret learning styles. In literature, there are several lists that give the general characteristics of the left hemispheric/auditory learner and the right hemispheric/visual learner. From Cummings' book (1985) Teaching Makes a Difference, there are the following lists:

LEFT HEMISPHERE	RIGHT HEMISPHERE
verbal	visual
abstract	intuitive
analytic	spatial
convergent	holistic
deductive	inductive
auditory	concrete
logical	divergent
	non-verbal

These characteristics are generally similar to lists presented by McCarthy (1983) and those presented by Dunn and Dunn (1978). McCarthy categorizes these characteristics into four types of learners: active experimental, concrete experience, reflective observational, and abstract conceptualizational. Dunn and Dunn incorporate these same characteristics but group the characteristics under five labels. The Dunn and Dunn categories are environmental, emotional, sociological, physical, and psychological. Each of these stimuli is further broken down into other subgroups. Regardless of the name of the label, professionals are realizing that different students have

different learning styles that can be utilized in the teaching/learning process.

According to the book, Teaching Students to Read Through Their Individual Learning Styles (Carbo, Dunn, R., & Dunn, K., 1986), students who have extreme right or left hemispheric preference learn under very different conditions. Right preference students learn better by kinesthetic instruction. They usually seem to have problems in conventional classrooms. They do not remember what they are told. Conventional schooling accommodates the left preference student who is more auditory through lecture and discussion presentations. By using testing instruments, such as Carbo's Reading Style Inventory, educators can have indicators of a student's learning style.

In the first chapter, it was mentioned that Price et al (1981) conducted research to see if there were basic similarities among the learning style preferences of gifted students. A statistical analysis was designed to determine which of the Learning Style Inventory variables discriminated significantly. Six of the twenty-four learning style variables were noted as significantly discriminating between the individuals who were gifted and who were not. Design, structure, responsibility, teacher motivated, persistence and sound were the elements that discriminated most between those subjects identified as gifted and those subjects identified as non-gifted. The research stated that on the above stated six variables, it

is possible to predict with 70% accuracy whether students fall into the non-gifted group. The implication in discussion was that certain learning styles can indicate a certain type of learner, meaning gifted or non-gifted.

The relationship between remedial students and learning styles is supported by Sharp (1982). The purpose of the research was to validate a testing instrument and to see if there was a relationship between cognitive style and reading achievement. The sample was 170 randomly selected fourth graders. Right hemispheric cognitive style was described as visual, concrete, whole, and intuitive. The total reading score was measured by the California Achievement Test. The cognitive style was measured by the Sigel Cognition Style Test. Point biserial correlations were used to test the correlation. To test the significance of the correlation, t-tests were utilized. A significant correlation ($p < .01$) was indicated for the low reading achievement/right cognition learning style. The hypothesis to validate a testing instrument by correlating its results to the Sigel Cognition Style Test was significance at $p < .05$. In the conclusion, the researcher states that based on the results of the study, cognitive learning styles as measured by the instruments, did demonstrate a reliable relationship with reading disabilities.

Further research was conducted by Sharp and Maring (1987) using teaching methods that take into consideration a child's learning style to see if instructional presentation

can increase achievement. In a case study of an eight year old boy, pretest and posttest were administered from the Woodcock Reading Master Test. The total teaching/learning environment was manipulated by Sharp to facilitate this one child's preference. A visual-spatial test indicated a visual weakness. He could not fit individual pieces together into the whole design. He did considerably better with tasks that lent themselves to language or verbal, analytical reasoning. The main difficulty of the student was processing global information presented in spatial formats. The remediation program used the basal reader from the school district but did not emphasize phonetics or words in isolation. A holistic reading approach was used. Entry score on the Woodcock was at 1.8 grade level, ninth percentile. A re-evaluation of the child's reading on the Woodcock three months later showed a total reading score of 4.2 grade level, 78 percentile. This is an increase of almost 70% in three months of intervention. Taking into consideration a child's learning style can increase achievement.

Research indicates two areas that increase achievement. Achievement is increased by manipulating computer formats. This is supported in the research done by Tennyson and by Tobias. Achievement is increased by determining the kinesthetic/tactual or visual/auditory preference of the learner and providing instructional activities which accommodate that learning style. This is supported in the

research by Sharp and Maring. More research needs to be done to substantiate these findings.

The following section reviews research that combines the two areas, computer formats and learning styles, to see what interaction takes place.

Computer Software Format and Learning Styles

Bradley (1985), explored the relationship between students' information processing styles and Logo programming on the microcomputer. The educational implications and value of gaining insight into how human and machine processes interact would facilitate understanding and improve the teaching/learning process. The sample was twenty-six middle-class students in a private school. The students ranged from seven to eleven years in age. All students received the same instructions from the same teacher. Three pretests were given. The tests were the Stanford Achievement Test (SAT) for reading and math achievement, Gestalt Completion Test to measure analytic versus holistic processing, and the Hidden Patterns Test to identify field dependence or independence. A Logo achievement test was given after instruction. Four conclusions were drawn from the results of this study concerning processing styles and Logo programming. First, top-down processing correlated positively with LOGO programming success with a significance level of $p < .001$. Second, top-down processing correlated positively with field-independent tendencies as measured in the Hidden Pattern Test with a significance level of $p < .01$. Third, top-down processing correlated positively with holistic tendencies as measured by the Gestalt Completion Test with a

significance level of $p < .05$. Fourth, top-down processing correlated positively with general achievement as measured by the SAT test with a significance level of $p < .05$. In the discussion, it was stated that achievement may be related to the ability to formulate a broad idea about a task. A better understanding of students' thought processes and their relationship to instructional interventions may lead to a clearer understanding of the interactive nature of the teaching-learning process.

Another study that addresses the use of the computer and learning styles was done by Clements and Gullo (1984). The purpose of their research was to assess the effects of computer assisted instruction and computer programming on cognitive style (receptive vocabulary, impulsivity or reflectivity, and divergent thinking abilities). Eighteen six year old students were randomly assigned to one of two treatment groups: computer assisted instruction or computer programming. The experiment lasted twelve weeks. Cognition was tested by The Peabody Picture Vocabulary Test for receptive vocabulary. The Matching Familiar Figure Test was given for reflectivity or impulsivity. The Torrance Test of Creative Thinking was administered to test for divergent thinking. The programming group and the CAI group did not differ significantly prior to treatment as measured by a t-test. To determine if there were significant differences between the pretest and posttest scores on the Torrance test for the CAI and the Logo groups, a 2(group) x 2(pre-post) x

4 (subtest) analysis of variance was performed. For the programming group, there were significant differences from pretest to posttest on the following subtests: fluency, $p < .01$; originality, $p < .05$; and the overall divergent thinking score, $p < .01$. No significant difference was found in the CAI group. Because there were no alternate forms available for the remaining measures, the Logo and CAI groups were compared using t-tests following the treatment period. Analysis revealed the programming group required significant fewer probe questions on the two metacognitive tasks than the CAI group: game task, $t(16) = -3.54$, $p < .01$; magic task, $t(16) = -2.87$, $p < .02$. Discussion stated that programming instruction may facilitate divergent thinking. The CAI treatment often emphasized convergent rather than divergent thinking. An example given in the discussion of divergent thinking was timed presentations of addition exercises. The conclusion was that programming experience on a computer can increase problem-solving divergent thinking skills. The small number of the sample population was noted with the suggestion that future research should replicate this study using larger sample sizes.

MacArthur, Haynes, and Malouf (1986), using learning disabled students, investigated two variables that might influence achievement between CAI drill and practice and independent seatwork: engaged time and interaction with teacher and peers. Twenty-four self-contained learning disabled students, ages nine to twelve years old, were

observed during computer time and during seatwork. A reliable observation instrument was developed and six observers were trained. Correlated t-tests were used to compare the proportion of time attending to content ($t = 3.11$, $p < .01$), and time spent off-task during computer time than during seatwork ($t = 6.84$, $p < .001$). Time interacting with teachers and peers during computer time and seatwork were not significantly different at the $p < .05$ level. The results indicated that CAI has potential as a means of increasing learning disabled students' attention to academic tasks.

Not all research supports the effectiveness of CAI. In a study by Bass and Ries (1986), the purpose was to see if microcomputer assisted instruction increased performance in low achieving students in math and reading. The sample group was 178 Chapter One students in fifth and sixth grade. Students assigned to the experimental group received microcomputer assisted instruction during Chapter One time while the control group received conventional Chapter One instruction. In order to determine whether students receiving supplementary CAI performed better than students receiving regular Chapter One instruction, reading and mathematics posttest scores were studied by the use of analysis of covariance, covarying statistically for the effects of pretest scores. F-ratios were computed to see if there were statistically significant amounts of variability among the groups consisting of fifth grade reading and math

and groups consisting of sixth grade reading and math. The conclusions were that low achieving students did not attain statistically significant pretest to posttest gains in math and reading using microcomputer assisted instruction. Although all microcomputer experimental groups showed statistically significant pretest/posttest gains in reading and math, the control groups using conventional instructional methods also showed similar gains. In discussion, several variables were mentioned that were out of the researchers' control which may have invalidated the research. One variable was that four teachers were involved which led to teacher variation. Another variable was the number of students in a class was controlled by administration. Plus, teachers in the control group were aware that they were part of the research. The conclusion was that the generalizing of the findings was restricted by the design limitations of the research. The variable not addressed in the critique of the research design was if the software format was the best for the remedial student.

The following research did focus on that variable. The purpose of the study by Norton and Resta (1986) was to assess how computers supported reading performance using three different formats: integrated learning systems (CAI), problem-solving software and simulation software. The integrated learning systems were tutorial or drill and practice. This was labeled a skill approach. The problem-solving software was viewed as reading as a problem-solving

process versus a preoccupation with words in isolation. The third software, simulation, was viewed as reading to gain information. The sample was 102 low achievers entering the fourth, fifth, and sixth grades, in a six week summer school computer reading class. In the population, 87% had been in a federal program for remediation. The students were randomly assigned into eleven classes. Each classroom used only one computer format. All students were given a pretest and posttest from Gates-MacGinite Reading Test. A higher level form of the test was given in the posttest. The Purdue Elementary Problem-Solving Inventory was also given to all students as a pretest/posttest. Each class period consisted of a half hour of instruction and a half hour of computer time. To test for significant difference between the three groups while statistically controlling for prior group differences on the pretest (covariant), data for the three groups was studied using analysis of covariance (ANCOVA). For those entering the fourth, fifth, or sixth grade, the ANCOVA results reflected significant difference in reading vocabulary ($F = 3.31$, $p < .05$), reading comprehension ($F = 3.46$, $p < .05$), and problem-solving ability ($F = 9.38$, $p < .05$). Since there was significant differences on all measures, the researchers used the Tukey method to test paired mean scores for significance. When the honest significant difference for reading vocabulary (HSD = 3.70) was compared with the mean score difference for the problem-solving and skill groups (4.69), the simulation

and skills groups (4.99), and the problem-solving and simulation groups (0.30), it was determined that significant differences existed between the skills group and both the problem-solving and the simulation group but not between the problem-solving and the simulation groups. Comparing the honest significant difference for reading comprehension (HSD = 3.23) with the mean score difference for the problem-solving and skill groups (3.54), the simulation and skills groups (3.76), and the problem-solving and simulation groups (0.22), significant difference was determined between the skills group and both the problem-solving and the simulation group but not between the problem-solving and the simulation groups. A third honest significant difference was computed for problem-solving ability (HSD = 2.62), compared with the mean score difference for the problem-solving and skills groups (6.88), the simulation and skills groups (7.49), and the problem-solving and simulation groups (0.61), and it revealed significant differences between the skills group and both the problem-solving and the simulation group but not between the problem-solving and the simulation groups. In discussion, it was noted that in all areas tested (reading vocabulary, reading comprehension, and problem-solving ability), those students entering the fourth, fifth or sixth grade profited more from instruction supplemented by problem-solving and simulation software. The implication was that reading ability is more closely linked with fluency in general problem-solving and sustained by domain-specific

problem-solving than with mastery of a set of discrete bits and pieces of the reading process. It was noted that there was a decline in mean scores in reading vocabulary, reading comprehension, and problem-solving ability for the skills group. There was no significant difference in gains made by students using problem-solving software and those using simulation software. The research findings support the use of problem-solving software and simulation software to impact reading performance of low achievers.

Summary

The research supports four statements. First, the ability to manipulate computer formats facilitates learning. Second, low achievers have similar learning characteristics categorized under the label kinesthetic/visual learning style. Third, when instruction accommodates the learning style of the student, achievement is increased. Fourth, low achievers' achievement is impacted by software format that is holistic in design.

Given a population of remedial students, research indicates that the majority of the students' learning style should be kinesthetic/visual. If this is true, then the computer format that would increase achievement would be software that presents information in a global format such as problem-solving or simulation software.

Problem Statement

Based on the review of literature, it has been found that learning style assessment instruments can be a predictor of right/kinesthetic preference or left hemispheric/auditory preference. Knowledge of the learning style could help in the selection and designing of instructional computer strategies to facilitate learning. Research has also indicated that low achievers tend to achieve more academically in reading using software with an open ended problem-solving or simulation design.

The following research hypothesis will address remedial students and their learning styles. With the analysis of the results of the study, more sophisticated teacher decisions can be made concerning appropriate software to facilitate learning.

Hypothesis

Using a Reading Style Inventory on Middle School students in an Idaho Chapter One Reading Lab will demonstrate that the students have excellent to good visual strengths and strong to moderate kinesthetic preferences.

CHAPTER III

Methodology

Sample

The population for this study was a sample of 31 sixth grade Chapter One students from a Middle School in the Coeur d'Alene, Idaho public school system. There were 12 girls and 19 boys. The age of the students ranged from 11 years, 2 months to 13 years, 6 months. The students were currently placed in a federal remedial program after an academic and performance review showing six months delay or more in achievement on the Iowa Test of Basic Skills (ITBS). The students in the population do not have learning disabilities and are not special education candidates.

Assessment Instrument

The students were given the Reading Style Inventory (RSI) published by Learning Research Associates, Inc. The RSI test was validated through a five year field test by Dr. Marie Carbo. A test-retest reliability study was conducted with the RSI in 1981 with 293 students in grades two, four six and eight, who were identified as good, average and poor readers, using the following definitions: a good reader is a student at least one and a half years above grade level on standardized tests, an average reader is no more than six months above or below grade level on standardized tests, a

poor reader is at least one and a half years below grade level on standardized tests. Test-retest reliability coefficients for the thirteen RSI subscales ranged from .67 to .77. The RSI scales with reliabilities of .70 or higher for all grade levels were: sound (.72), design (.71), motivation (.70), structure (.72), auditory perception (.74), visual perception (.77), kinesthetic perception (.75), and mobility (.76). The sample was drawn from both inner-city and suburban schools located in New York City and Nassau County, New York (Carbo, 1986).

The test gave a profile of the student's reading style with five subsections: perceptual strengths, preferred reading environments, emotional profile, sociological preference and physical preference. (See Appendix A) For the purpose of this study, we are concerned with two categories in the perceptual strengths profile subsection. The categories of interest are visual/auditory strengths and kinesthetic/tactual preferences. The four degrees of visual/auditory strength are strong, good, moderate, and poor. The four degrees of kinesthetic/tactual preference are strong, moderate, mild, and none.

Procedure

The Reading Style Inventory (RSI) was given by computer in the Chapter One Reading Lab. One computer was set off to the side of the room for the purpose of this research. The classroom teacher continued normal instruction as one student at a time went through the program. The researcher

was present to insure the computer worked correctly and to clarify any concerns of the student. The directions on running the program were given by the program on the monitor screen. The student was asked 52 questions. The time required to complete the program was approximately 20 minutes. The readability of the inventory was fourth grade level. The computer compiled the answers into patterns and gave an individual print-out of each student's profile. (See Appendix A)

CHAPTER IV

Results

A count was taken on how many students received strong, good, moderate, and poor ratings in the visual/auditory strength category. Figure 1 illustrates that in the visual strength area 4 students rated "excellent," 13 students rated "good," 8 students rated "fair" and 6 students rated "poor." Of these 31 Chapter One students, 55% were in the excellent to good range of visual strength. In the auditory strength area, 7 students rated "excellent," 5 students rated "good," 11 students rated "fair" and 8 students rated "poor." Only 39% of the Chapter One students were in the excellent to good range in auditory strength.

Insert Figure 1 about here

A count was taken on how many students received strong, moderate, mild or none in the ratings on the kinesthetic/tactual preference. Figure 2 illustrates that in the kinesthetic preference category, 21 students were in the "strong" range and 10 students were in the "moderate" range. No students were in the "mild" or the "none" range. All of the Chapter One students were in the strong to moderate range of kinesthetic preference. In the tactual preference category, 4 students were in the "strong" range, 19 students were in the "moderate" range, 7 students were in

the "mild" range and 1 student was in the "none" range. In the tactual preference category, 74% of the Chapter One students were in the strong to moderate range.

Insert Figure 2 about here

Table 1 shows each student's individual scores on the four dimensions.

Insert Table 1 about here

CHAPTER V

Discussion

The hypothesis that Chapter One students would have strong to moderate kinesthetic preferences was supported by the results of the Reading Style Inventory (RSI). The instrument showed that 100% of the Chapter One sixth graders had strong to moderate kinesthetic preference and 74% had strong to moderate tactual preference. The RSI also showed that 55% of the students had high visual strength and 39% had high auditory strength.

The review of research states that differences in preferences and strengths suggests that learning can be accomplished for different people through different approaches (Sharp 1987).

According to Carbo et al (1986), kinesthetic learners, such as the Chapter One students, need a global/kinesthetic approach to reading. In a kinesthetic approach, the whole story should be introduced in its entirety by oral reading or tape recording so the words are in meaningful context. The kinesthetic learner gets wrapped up in a story and does not concentrate on the facts. They use the context of the story to figure out unknown words. They do not apply phonetic rules. This information can be applied to computer formats. Some formats, such as problem-solving and simulation software, presents information in a holistic approach. This concept was supported by the research of

Norton and Resta (1986). They found that remedial readers made better gains when the computer software was problem-solving or simulation than with software that was skill orientated. In problem-solving and simulation software, a student is reading for information. In discussion, Norton states that reading ability is more closely linked with fluency than with mastery of a set of discrete bits and pieces of the reading process. The skill of reading should not be isolated from the comprehension in the reading act.

The traditional curriculum has tended to view the reading process as the accumulation of discrete bits of information and the mastery of specified skills believed to add up to a whole. Conversely, gains in achievement made by the problem-solving and simulation software suggests that the reading process for the remedial student needs to be presented kinesthetically, meaning holistic and global.

This research on the Chapter One students shows that these remedial students are kinesthetic preference learners. When you apply this information to a decision on computer software, the format that lends itself to the holistic approach is simulation and problem-solving software. The computer can be used as an educational tool for remedial readers by using software that allows for reading for meaning.

This does not mean that other formats are not meaningful in the educational setting. The visual/tactual learners process information sequentially and logically with

the information presented in small steps. They enjoy learning facts such as dates, names and other specifics. (Carbo et al, 1986). Computer software format based on drill and practice or tutorial lends itself to this type of learner.

Further research in this area is needed. This study needs to be replicated to see if another Chapter One sample would yield the same results. It would be interesting to compare these results to the profiles of non-remedial students. Each of these sample groups need to be studied to see if by matching their learning styles to specific software their achievement would be increased. If that research would prove to be true, then this inventory is an instrument to refine and improve individualized instruction.

The fact that 100% of the Chapter One students tested kinesthetic is of concern. It raises the question of the adequacy of the testing instrument. Possibly the questions are such that they tend to identify the kinesthetic learner more than the tactual learner. The formulas for converting the students responses to the learning style categories is not available. As a greater number of students are tested, this area could be addressed.

The relationship of the kinesthetic and tactual variables needs to be clarified. In learning styles, tactual preference means learning through the sense of touch. Kinesthetic preference means learning through all senses including the sense of touch. A concern is if the

testing instrument keeps the variables, kinesthetic and tactual, independent of each other. Do these two characteristics vary together or can they vary separately? Further research is needed to address this area.

In the area of matching computer software to learning styles, the authorship ability of word processing and some tutorial software may deal with the holistic processing approach that lends itself to the remedial student. Research needs to be done investigating other computer formats available to teachers and their impact on the reading achievement of the remedial student.

The computer will have more impact on the reading curriculum when educators apply what can be learned by Reading Style Inventories. Individualizing the computer format to match a student's learning style will maximize the predictability of successful learning. In this way, the computer is a tool to be used to build on the strengths and preferences of the individual student.

Bibliography/References

Allen, B., & Merrill, M. (1985). System-assigned strategies and CBI. Journal of Educational Computing Research, 1, 3-19.

Bass, G. & Ries, R. (1986). Teaching basic skills through microcomputer assisted instruction. Journal of Educational Computing Research, 2, 207-219.

Becker, H. (Winter, 1983/84). Schools uses of microcomputers: Report #2 from a national survey. The Journal of Computers in Mathematics and Science Teaching, 4, 16-21.

Becker, H. (Fall, 1983). Schools uses of microcomputers: Report #1 from a national survey. The Journal of Computers in Mathematics and Science Teaching, 3, 29-33.

Bitter, G. (1980). Survey of Arizona public school practices and needs for computer assisted instruction. College of Education at Arizona State University. (ERIC Document Reproduction Service No. ED 218-704).

Bitter, G. & Camusa, R. (1984). Using a microcomputer in the classroom. Reston, Virginia: Prentice-Hall.

Bradley, C. (1985). The relationship between students' information processing styles and logo programming. Journal of Educational Computing Research, 1, 427-433.

Carbo, M., Dunn, R., & Dunn, K. (1986). Teaching students to read through their individual learning styles. A Reston Book, Prentice-Hall, Englewood Cliffs, New Jersey, p. 253-264.

Carini, P. (1982). The school lives of seven children: A five year study. Center for Teaching and Learning, North Dakota University, Grand Forks, North Dakota, (ERIC Document Reproduction Service No. ED 272-301).

Clements, D., & Gullo, D. (1984). Effects of computer programming on young children's cognition. Journal of Educational Psychology, 76, 1051-1058.

Cummings, C. (1985). Teaching makes a difference, Teaching Inc., Snohomish Publishing Co., p. 106.

Dunn, R., & Dunn, K. (1979). Mike Hughes: Case study to test your diagnostic and prescriptive skills. National Association of Secondary School Principals, 63, 71-79.

Dunn, R., & Dunn, K. (1978). Teaching students through their individual learning styles: A practical approach. Reston Publishing Co., Inc., A Prentice - Hall Co., Reston, Virginia (pp. 1-24, 359-400).

Feurzeig, W., Horwitz, P., & Nickerson, R. (1981). Microcomputers in education report #4798 (ERIC Document Reproduction Services No. ED 208-901).

Gazzaniga, M., Bogen, J., & Sperry, R. (1965). Observations on visual perception after disconnexion of the cerebral hemispheres in man. Brain, 88, 221-236.

Griggs, S. (1985). Counseling students through their individual learning styles. ERIC Counseling and Personnel Services Clearinghouse School of Education, University of Michigan, Ann Arbor, Michigan, published by ERIC/CAPS (ERIC document Reproduction Service No. ED 265-452).

Harris, A. (1979). Lateral dominance and reading disability. Journal of Learning Disabilities, 12, 337-343.

Heines, J. (1984). Screen design strategies for computer-assisted instruction. Bedforn, Mass: Digital Equipment Corp.

James, W., & Galbraith, M. (1985). Perceptual learning styles: Implications and techniques for the practitioner. Lifelong Learning, 8, 20-23.

Levy, J., Trevarthen, C., & Sperry, R. (1972). Perception of bilateral chimeric figures following hemispheric deconnexion. Brain, 95, 61-78.

MacArthur, C., Haynes, J., & Malouf, D. (1986). Learning disabled students' engaged time and classroom interaction: The impact of computer assisted instruction. Journal of Educational Computing Research, 2, 189-198.

McCann, P. (1981). Learning strategies and computer-based instruction. Computing and Education, 5, 133-140.

McCarthy, B. (1983). The 4mat system: Teaching to learning styles with right/left mode techniques, A cycle of learning. Second Edition, Oak Brook, Ill.: Excell, Inc.

McCombs, B., Eschenbrenner, A., & O'Neil, H. (1973, April). An adaptive model for utilizing learner characteristics in computer based instructional systems. Educational Technology, 13, 27-51.

Merrill, M.D. (1980). Learner control in computer based learning. Computing and Education, 4, 77-95.

Mitchell, J. (1985). The ninth mental measurements yearbook, 1, Buros Institute of Mental Measurements, University of Nebraska, Lincoln, Nebraska, p. 841.

Niemiec, R., & Walberg, H. (1985). Computers and achievement in the elementary school. Journal of Educational Computing Research, 1, 435-440.

Norton, P., & Resta, V. (1986). Investigating the impact of computer instruction on elementary students' reading achievement. Educational Technology, 26, 35-41.

Price, G., Dunn, K.,Dunn, R., & Griggs, S. (1981). Studies in students' learning styles. Roeper Review, 4, 38-40.

Rapaport, P., & Savard, W. (1981). Computer assisted instruction. Produced for the conference on microcomputers in today's schools, Northwest Regional Educational Lab, Portland, Ore. (ERIC Document Reproduction Service No. ED 213-393).

Rhetts, J. (1974). Task, learner, and treatment variables in instructional design. Journal of Educational Psychology, 66, 339-347.

Ribble, R., Millman, J., & Glock, M. (1969). Learner characteristics and instructional mode: A search for disordinal interactions. Journal of Educational Psychology, 60, 113-120.

Schmidt, M., Weinstein, T., Niemiec, R., & Walberg, H. (1985-86). Computer assisted instruction with exceptional children. Journal of Special Education, 19, 493-501.

Sharp, P. (1982). An inventory of cognitive style: Validity, reliability, and correlation with reading achievement. A dissertation for a doctorate of philosophy, Washington State University.

Sharp, P., & Maring, G. (1987). Brain functioning and reading remediation: progress in research and practice. Submitted for publication, Department of Elementary and Secondary Education, Washington State University, Pullman, Washington.

Tennyson, Robert D. (1980). Instructional control strategies and content structure as design variables in concept acquisition using computer-based instruction. Journal of Educational Psychology, 72, 525-532.

Tobias, S. (1973). Distraction, response mode, anxiety, and achievement in computer assisted instruction. Journal of Educational Psychology, 65, 233-237.

Zenhausern, R., Dunn, R., Cavanaugh, D., & Eberle, B. (1980). Do left and right "brained" students learn differently? Roeper Review, 3, 36-40.

APPENDIX A

INDIVIDUAL READING STYLE PROFILE

DATE OF PROFILE-02/02/88 GRADE-6 RL-

STDNT NAME- DOB-09/29/76

DIAGNOSIS	RECOMMENDED STRATEGIES FOR TEACHG READG
PERCEPTUAL STRENGTHS/PRFRNCES	
POOR AUDITORY STRENGTHS	LIMT LISTNG ACTVTIES FOCUSING ON DECODG
GOOD VISUAL STRENGTHS	USE VISUAL AIDS(WORD CARDS, BOARD WORK)
MODERATE TACTUAL PREFRNCES	USE TACTUAL ACTVTIES (WRITING, TYPING)
STRONG KINESTH PREFRNCES	COMBINE READG W/BUILG/DOING/FLOOR GAMES
PREFERRED READING ENVIRONMENT	
MUSIC	MAKE AVAILABLE MUSIC THRU HEADSETS
QUIET OR TALKING	SOUND (TALKING) ISNT A FACTOR FOR STDNT
BRIGHTLY OR DIMLY LIT	LIGHT ISNT A FACTOR FOR STDNT
WARM TEMPERATURES	ALLOW STDNT READ WARMEST AREA OF ROOM
INFORMAL DESIGN	PRVIDE SOFT CHAIRS/COUCHES,RUGS,PILLOWS
NOT ORGANIZED	PRVIDE VARIETY READG MATERIAL FOR BROWSG
EMOTIONAL PROFILE	
THIS STUDENT IS:	
NOT PEER-MOTIVATED	DONT REQR SHARE READG INTRSTS W/PEERS
NOT ADULT-MOTIVATED	DONT REQR SHARE READG INTRSTS W/TCHRS
SELF-MOTIVATED	PRVIDE MANY OPPORTUNITIES TO READ
FAIRLY PERSISTENT	PRVIDE SHORT & LONGER-TERM ASSGNMNTS
NOT RESPONSIBLE	GIV SHORT ASSGNMNTS,FEW/NO OPTIONS
THIS STUDENT PREFERS:	
MANY CHOICES	PRVIDE LARGE VARIETY READG MATERIALS
LITTLE/NO DIRECTION	PRMIT MANY OPTIONS,FLEXIBLE TIME LIMITS
WORK CHKD IMMEDIATELY	PRVIDE BRIEF TASKS;CHECK AS COMPLETED
WORK CHKD BY SELF	PRVIDE SELF-CHKG MATERIALS;MONITR PROGRS
SOCIOLOGICAL PREFERENCES	
NOT TO READ TO A TCHR	DONT SCHDULE STDNT READ TO TCHR OFTEN
NOT TO READ W/PEERS	DONT SCHDULE STDNT READ W/PEERS OFTEN
TO READ ALONE	SCHDULE STDNT TO READ ALONE
NOT TO READ W/PEERS/TCHR	DONT SCHDULE TO READ W/PEERS/TCHR OFTEN
NOT TO READ W/ONE PEER	DONT SCHDULE TO READ W/ONE PEER OFTEN

Table 1
List of individual profiles on the Reading Style Inventory sorted on kinesthetic preference.

student	auditory	visual	tactual	kinesthetic
1	poor	fair	moderate	strong
2	poor	good	mild	strong
3	poor	good	moderate	strong
4	fair	poor	mild	strong
5	fair	poor	mild	strong
6	fair	poor	strong	strong
7	fair	fair	moderate	strong
8	fair	good	moderate	strong
9	fair	good	mild	strong
10	fair	good	moderate	strong
11	good	good	moderate	strong
12	good	good	moderate	strong
13	good	good	moderate	strong
14	good	good	strong	strong
15	good	excellent	moderate	strong
16	excellent	fair	moderate	strong
17	excellent	fair	moderate	strong
18	excellent	good	strong	strong
19	excellent	good	moderate	strong
20	excellent	good	strong	strong
21	excellent	excellent	mild	strong
22	poor	poor	none	moderate
23	poor	poor	mild	moderate
24	poor	poor	moderate	moderate
25	poor	fair	moderate	moderate
26	poor	fair	moderate	moderate
27	fair	fair	mild	moderate
28	fair	good	moderate	moderate
29	fair	fair	moderate	moderate
30	fair	excellent	moderate	moderate
31	excellent	excellent	moderate	moderate

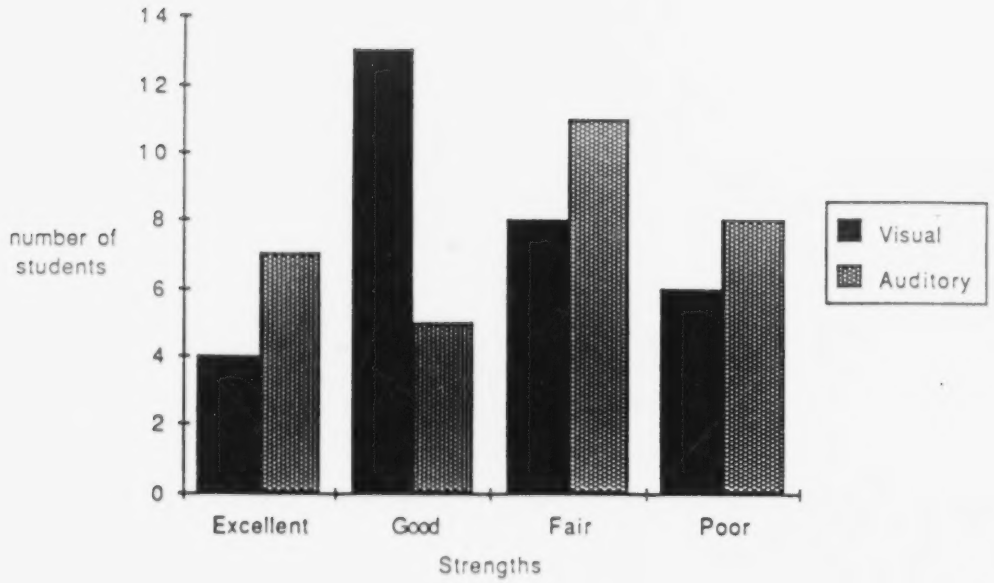

Figure 1: This chart shows the number of Chapter One sixth graders in each of the four categories for visual and auditory strengths.

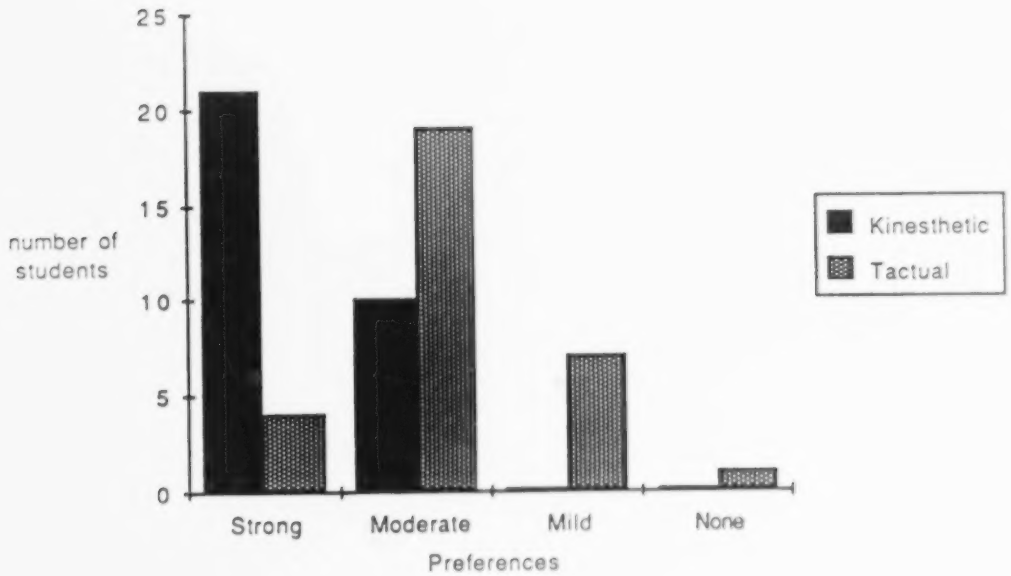

Figure 2: This chart shows the number of Chapter One sixth graders in each of the four categories for kinesthetic and tactual preferences.